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Shirai

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(54) **EFFECT APPLYING APPARATUS AND EFFECT APPLYING METHOD**

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(51) **Int. Cl.**

H02B 1/00	(2006.01)
H04R 3/00	(2006.01)
H04H 60/04	(2008.01)
G10H 1/00	(2006.01)
G10H 1/46	(2006.01)

(52) **U.S. Cl.**

CPC ***H04R 3/00*** (2013.01); ***G10H 1/0091*** (2013.01); ***G10H 1/46*** (2013.01); ***H04H 60/04*** (2013.01); *G10H 2210/281* (2013.01); *G10H 2250/041* (2013.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

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(57) **ABSTRACT**

When a knob is at a center position, transmission levels of first volumes on a path from a second effector to a first effector, and second volumes on a path from the first effector to the second effector are both zero, and the first effector and the second effector operate independently. When the knob is displaced to right side from the center position, the transmission level of the second volumes is controlled according to the displacement amount, but the transmission level of the first volumes stays at zero. Thus, the second effector is connected in series to the first effector. When the knob is displaced to left side from the center position, the transmission level of the first volumes is controlled according to the displacement amount, but the transmission level of the second volumes stays at zero. Thus, the first effector is connected in series to the second effector.

13 Claims, 4 Drawing Sheets

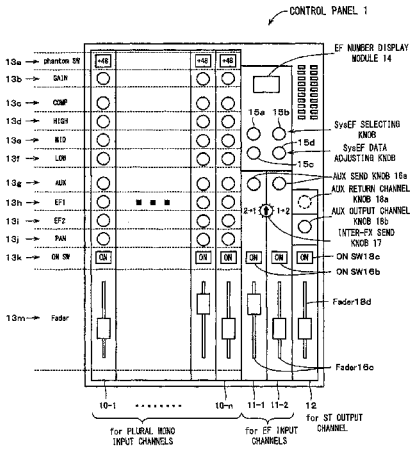


Fig. 1

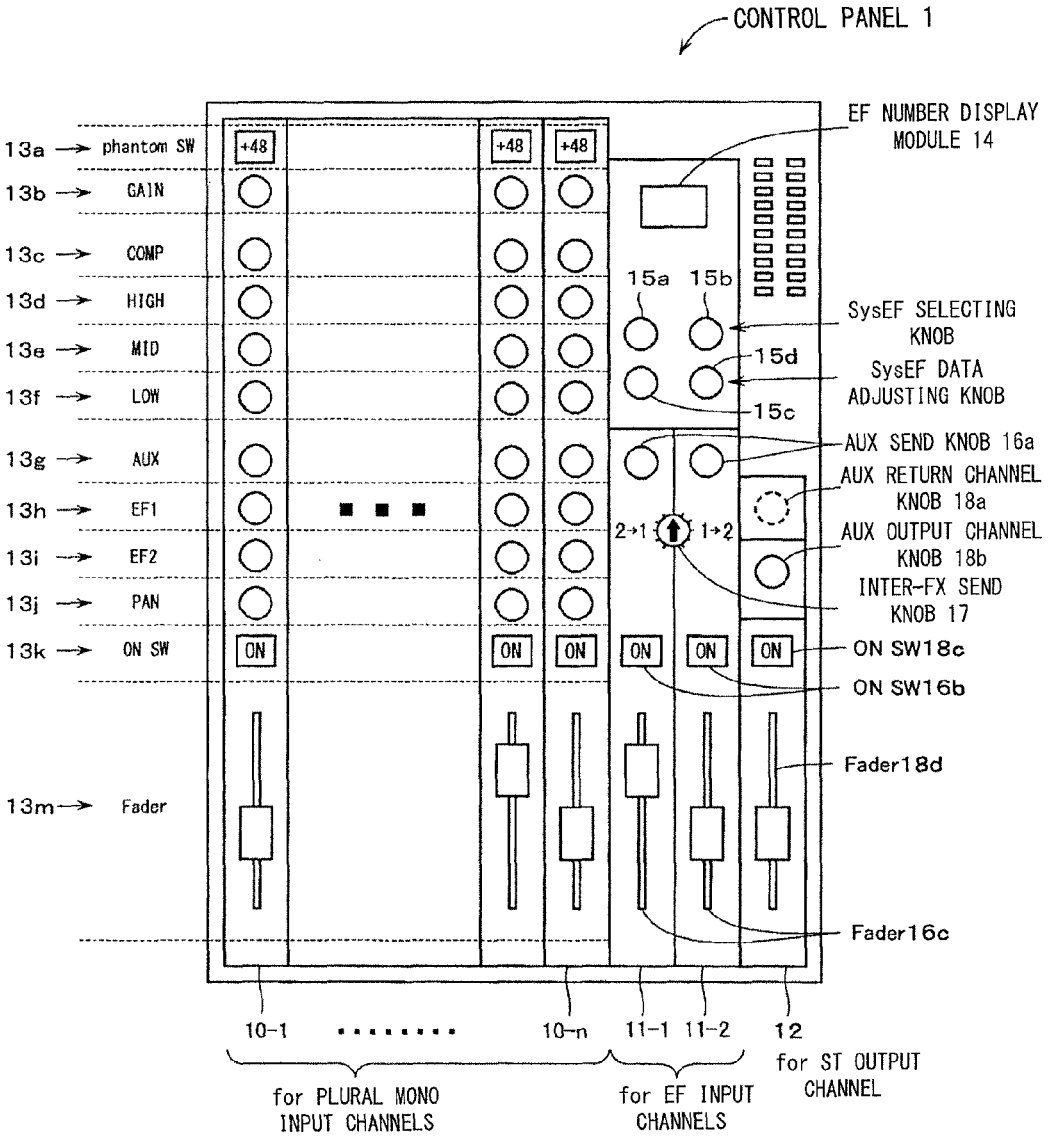

CONTROL PANEL 1
EF NUMBER DISPLAY MODULE 14
13a phantom SW
13b GAIN
13c COMP
13d HIGH
13e MID
13f LOW
13g AUX
13h EF1
13i EF2
13j PAN
13k ON SW
13m Fader
+48
ON
15a 15b
SysEF SELECTING KNOB
15d
SysEF DATA ADJUSTING KNOB
15c
AUX SEND KNOB 16a
AUX RETURN CHANNEL KNOB 18a
2→1 1→2
AUX OUTPUT CHANNEL KNOB 18b
INTER-FX SEND KNOB 17
ON SW18c
ON SW16b
Fader18d
Fader16c
10-1 10-n 11-1 11-2 12
for PLURAL MONO INPUT CHANNELS
for EF INPUT CHANNELS
for ST OUTPUT CHANNEL

Fig. 2

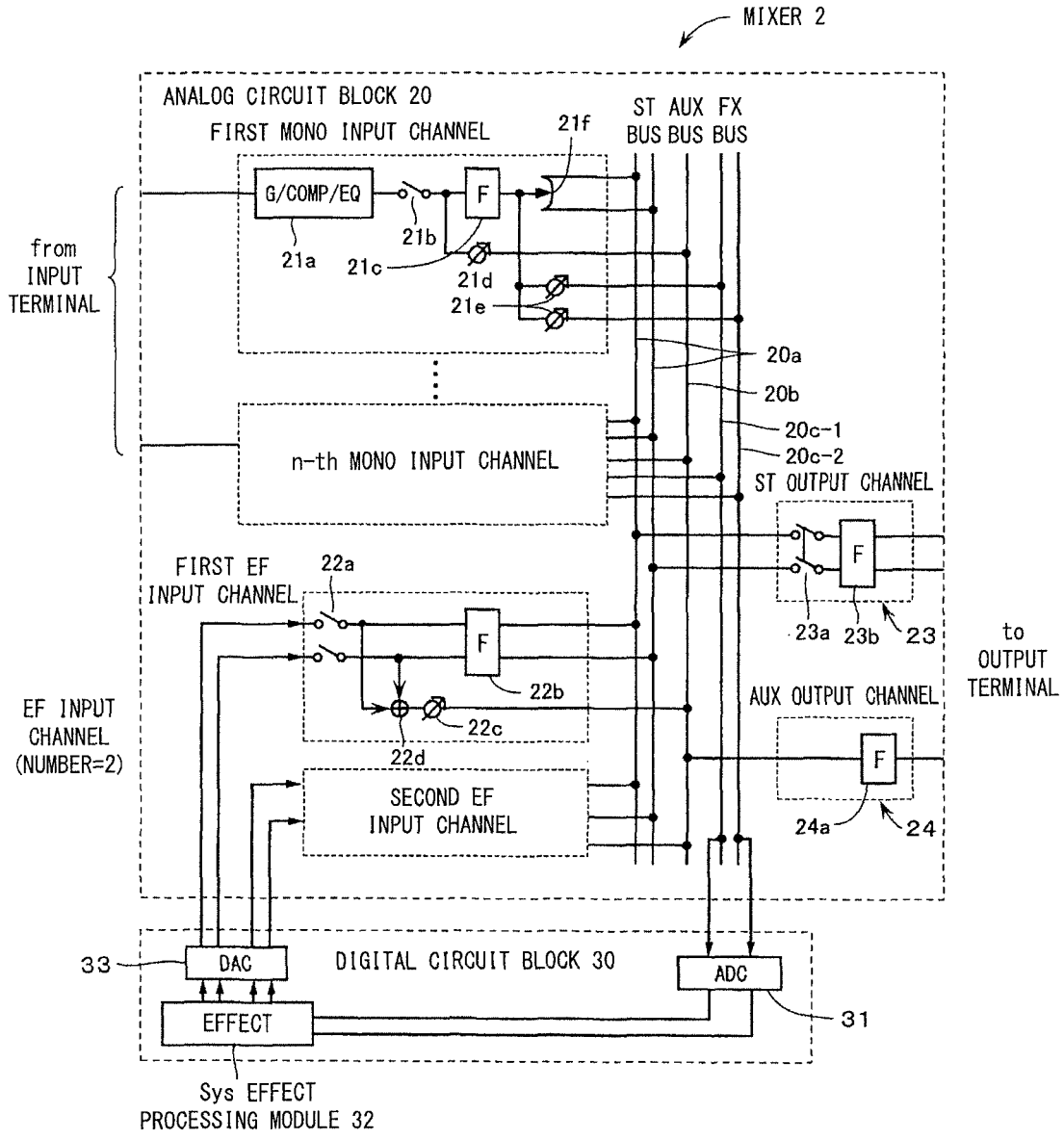

MIXER 2
ANALOG CIRCUIT BLOCK 20
FIRST MONO INPUT CHANNEL
21f
ST AUX FX
BUS BUS BUS
G/COMP/EQ
F
21a
21b
21c
21d
21e
from
INPUT
TERMINAL
20a
20b
20c-1
20c-2
n-th MONO INPUT CHANNEL
ST OUTPUT CHANNEL
F
FIRST EF
INPUT CHANNEL
22a
F
22b
22c
22d
23a
23b
23
to
OUTPUT
TERMINAL
EF INPUT
CHANNEL
(NUMBER=2)
AUX OUTPUT CHANNEL
F
SECOND EF
INPUT CHANNEL
24a
24
33
DAC
DIGITAL CIRCUIT BLOCK 30
ADC
EFFECT
31
Sys EFFECT
PROCESSING MODULE 32

Fig. 3

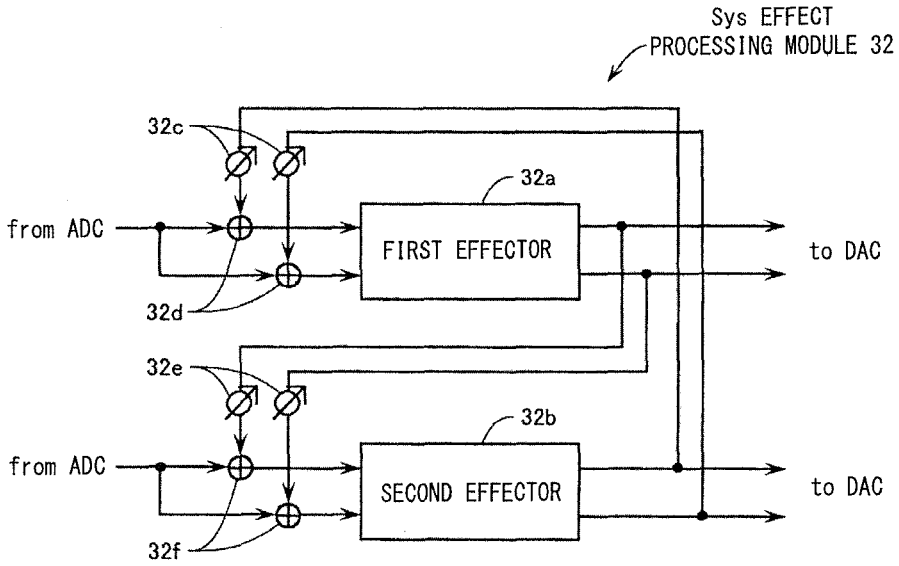

Sys EFFECT
PROCESSING MODULE 32
32c
32a
from ADC
FIRST EFFECTOR
to DAC
32d
32e
32b
from ADC
SECOND EFFECTOR
to DAC
32f

Fig. 4

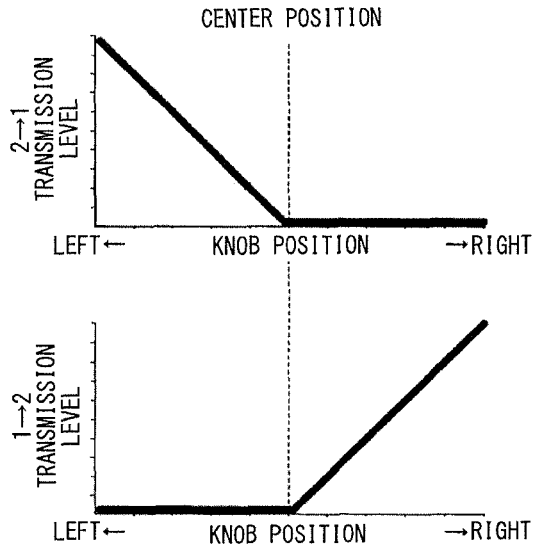

CENTER POSITION
2→1 TRANSMISSION LEVEL
LEFT←
KNOB POSITION
→RIGHT
1→2 TRANSMISSION LEVEL
LEFT←
KNOB POSITION
→RIGHT

Fig. 5

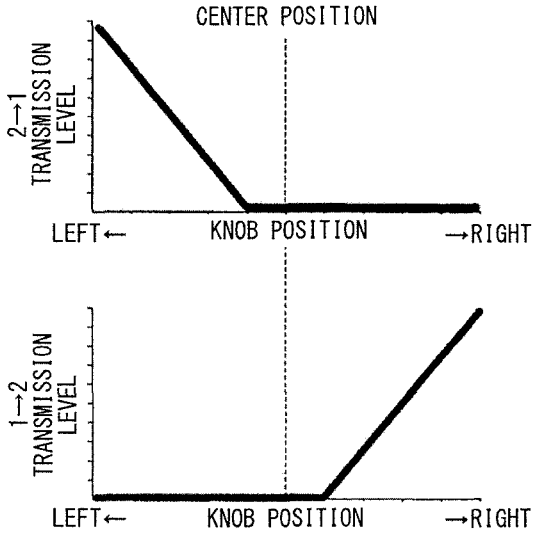
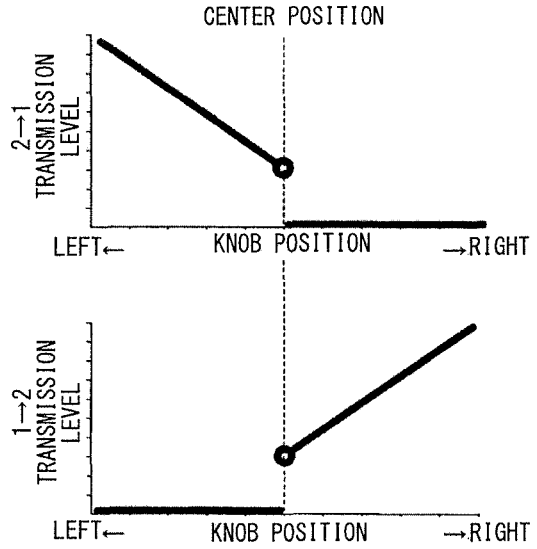

CENTER POSITION
2→1 TRANSMISSION LEVEL
LEFT←
KNOB POSITION
→RIGHT
1→2 TRANSMISSION LEVEL
LEFT←
KNOB POSITION
→RIGHT

Fig. 6


CENTER POSITION
2→1 TRANSMISSION LEVEL
LEFT←
KNOB POSITION
→RIGHT
1→2 TRANSMISSION LEVEL
LEFT←
KNOB POSITION
→RIGHT

EFFECT APPLYING APPARATUS AND EFFECT APPLYING METHOD

TECHNICAL FIELD

The invention relates to an effect applying apparatus and an effect applying method which enable switching of connection between a first effector applying a first audio effect and a second effector applying a second audio effect and level adjustment of an audio signal supplied from one effector to another effector when the switching is performed to connect the effectors.

BACKGROUND ART

In a conventional mixer described in NPL 1 which mixes sounds and the like collected with multiple microphones and sends the mixed sounds to a power amplifier and various recording apparatuses, two systems of effectors are provided, and each effector applies an effect such as reverb or delay to each audio signal inputted to the system in which it is provided. In this case, when the effector of one system is a delay and an effector of the other system is a reverb, there may be cases where it is desired to apply the reverb after the delay is applied. However, in this conventional mixer, although the two systems of effectors are provided, there is no connection between the systems, and thus an output of one effector cannot be supplied to the other effector. Specifically, it is possible to apply the delay in one system and apply the reverb in the other system simultaneously, but it is not possible to apply the reverb by the effector of the other system to an audio signal to which the delay is applied by the effector of the one system.

Further, in a conventional effector described in NPL2, effectors of a modulation stage and a reverb stage are provided in series, and a reverb can be applied in the reverb stage to an audio signal to which an audio effect is applied in the modulation stage. The order of the effector in the modulation stage and the effector in the reverb stage is replaced in a toggle manner in the series of effectors which are applied sequentially, according to operation on a switch by the user. However, this conventional effector only has one system, and thus the effectors in the modulation stage and the reverb stage are not assumed to be used in different systems from each other.

Moreover, in the conventional effect applying apparatus described in PTL1, effect units are provided respectively in plural systems, and a wiring status between the systems of the effect units can be set. In this case, modes of wiring statuses are set in advance, and a wiring status of a predetermined mode can be set by the user by selecting a wiring selection number. In this conventional effect applying apparatus, an effect can be applied to each of audio signals of the plural systems, and by selecting a wiring status in which an audio signal to which an effect is applied in one system is inputted to another system, a further effect can be applied in the another system to the audio signal to which the effect is applied in the one system. Further, in this conventional effect applying apparatus, the user can set or edit parameters of effects in the effect units in the respective systems by operating controls provided on an operating panel.

CITATION LIST

Non Patent Literature

{NPL1} Yamaha Corporation, MIXING CONSOLE MGP16X MGP12X Owner's Manual (in Japanese), pp. 22-23, [online], [searched on Aug. 24, 2011], the Internet <http://www2.yamaha.co.jp/manual/pdf/pa/japan/mixers/mgp16x_ja_om_b0.pdf>

{NPL2} Yamaha Corporation, BASS SIMUL-EFFECT PROCESSOR FX500B Operation Manual (in Japanese), p. 17, [online], [searched on Aug. 24, 2011], the Internet <http://www2.yamaha.co.jp/manual/pdf/pa/japan/signal/FX500BJ.pdf>

Patent Literature

{PTL1} JP 3192767 B2

SUMMARY OF INVENTION

Technical Problem

In the conventional effect applying apparatus, a wiring status for inputting an audio signal to which an audio effect is applied by an effector of one system to an effector of another system so as to apply a further audio effect thereto is made by selecting a wiring status with a selecting control provided on an operating panel. Then, level adjustment of the audio signal supplied from the effector of the one system to the effector of the another system is performed with a controlling control for parameter setting provided on a panel control. Thus, there is a problem that the two controls, the selecting control and the controlling control, are necessary on the operating panel in the conventional effect applying apparatus.

Accordingly, it is an object of the invention to provide an effect applying apparatus and an effect applying method which enable intuitive use of switching of connection between effectors and level adjustment of an audio signal supplied from one effector to another effector without increasing a disposition space of controls.

Solution to Problem

To achieve the above object, the invention provides an effect applying apparatus including: a first effector for applying a first audio effect to an audio signal supplied to the first effector; a second effector for applying a second audio effect to an audio signal supplied to the second effector; a control which can be displaced by an operation by a user; and a controller for switching connection between the first effector and the second effector, and controlling level of an audio signal supplied from one of the effectors disposed in a previous stage to another of the effectors disposed in a subsequent stage, according to amount of displacement of the control from a predetermined position.

The above and other objects, features and advantages of the invention will be apparent from the following detailed description which is to be read in conjunction with the accompanying drawings.

Advantageous Effects of Invention

According to the invention, according to amount of displacement from an operating reference position of a control unit, an audio signal to which a first or second audio effect is applied by an effector disposed in a previous stage is supplied to an effector disposed in a subsequent stage, and a second or first audio effect is further applied to the audio signal. Further, level of the audio signal from the effector disposed in the previous stage is adjusted according to the amount of displacement from the operating reference posi-

tion of the control unit, and the adjusted audio signal is supplied to the effector provided in the subsequent stage. Thus, two operations can be performed with one operating unit, which are switching of connection between a first effector and a second effector and level adjustment of an audio signal supplied from the effector disposed in the previous stage to the effector disposed in the subsequent stage. Thus, increase in disposition space of the control unit can also be prevented as much as possible.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a diagram illustrating a structure of an operating panel on a mixer including an embodiment of an effect applying apparatus of the invention.

FIG. **2** is a circuit block diagram illustrating an overall image of mixing processing in the mixer illustrated in FIG. **1**.

FIG. **3** is a circuit block diagram illustrating a structure of a sys effect processing module of the mixer illustrated in FIG. **1** and FIG. **2**.

FIG. **4** is a diagram illustrating an example of transmission levels according to a knob position in the mixer illustrated in FIG. **1** and FIG. **2**.

FIG. **5** is a diagram illustrating another example of transmission levels according to a knob position.

FIG. **6** is a diagram illustrating still another example of transmission levels according to a knob position.

FIG. **7** is a circuit block diagram illustrating another structure of the sys effect processing module.

DESCRIPTION OF EMBODIMENTS

FIG. **1** illustrates a structure of an operating panel on a mixer including an embodiment of an effect applying apparatus of the invention.

The operating panel **1** of the mixer illustrated in FIG. **1** includes a monaural input section, an internal effect section, an effect input section, and so on. To the monaural input section, n pieces of channel strips **10-1**, . . . , **10-*n*** for plural monaural input channels (mono input channels) belong. In the illustrated example, the number of mono input channels is eight (n=8).

To the internal effect section, an EF number display module **14**, SysEF selecting knobs **15*a***, **15*b***, and SysEF data adjusting knobs **15*c***, **15*d*** belong. To the effect input section, two channel strips **11-1**, **11-2** for two effect input channels (first and second EF input channels) belong. Status and parameter of the first EF input channel can be set by the channel strip **11-1**, status and parameter of the second EF input channel can be set by the channel strip **11-2**. An AUX send knob (AUX) **16*a***, an ON switch (ON SW) **16*b***, and an effect fader (Fader) **16*c*** are provided in each of the channel strips **11-1**, **11-2**. Further, to the effect input section, an AUX return channel knob **18*a*** belongs, and an inter-FX send knob **17** belongs, which is provided across the boundary between the channel strip **11-1** and the channel strip **11-2**. Moreover, in the operating panel **1**, an AUX output channel knob **18*b*** and one channel strip **12** for one stereo output channel (ST output channel) are provided.

Statuses and parameters of respective input channels of the first mono input channel to n-th mono input channel can be set by the channel strips **10-1** to **10-*n*** of the monaural input section, and controls including a phantom switch (phantom SW) **13*a*** and a gain adjusting knob (GAIN) **13*b***, a compressor adjusting knob (COMP) **13*c***, a high-band adjusting knob (HIGH) **13*d***, a mid-band adjusting knob (MID) **13*e***, a low-band adjusting knob (LOW) **13*f***, an AUX send knob (AUX) **13*g***, a first FX send knob (EF1) **13*h***, a second FX send knob (EF2) **13*i***, a localization position adjusting knob (PAN) **13*j***, a channel switch (ON SW) **13*k***, and a channel fader (Fader) **13*m*** are provided in each of the channel strips **10-1** to **10-*n***.

Among these controls, the phantom SW **13*a*** is a phantom switch for performing control to provide a phantom power supply to a condenser microphone when a microphone for gathering sound, which inputs sound to each of input channels of the first to n-th mono input channels, is a condenser microphone.

Among the controls belonging to the internal effect section, the SysEF selecting knob **15*a*** is a knob for selecting a type of effect, such as various reverbs and various delays, of a first effector from among eight types for example, and the SysEF selecting knob **15*b*** is a knob for selecting a type of effect, such as various reverbs and various delays, of a second effector from among sixteen types for example. The numbers of the effect types selected by the SysEF selecting knobs **15*a***, **15*b*** are displayed on the EF number display module **14**. Further, the SysEF data adjusting knobs **15*c***, **15*d*** are controls for adjusting parameters of the effects selected by the SysEF selecting knobs **15*a***, **15*b***.

The AUX return channel knob **18*a*** which belongs to the effect input section is a control for adjusting level of an audio signal to which an effect is applied, which is to be sent to an ST (stereo) bus from an external effector when the external effector is used for application of effect, and an audio signal outputted from an FX bus is sent to the external effector. When the external effector is not used, it is possible to omit this AUX return channel knob **18*a***. Further, the AUX output channel knob **18*b*** provided on the operating panel **1** is a control for adjusting level of an audio signal outputted from an AUX output terminal, which is an output terminal of an AUX bus. Note that the audio signal from the AUX output terminal is sent to the above-described external effector, a monitor speaker for performer, or the like.

Next, FIG. **2** illustrates a circuit block diagram illustrating an overall image of mixing processing in a mixer **2** having the operating panel **1** illustrated in FIG. **1**.

In FIG. **2**, the mixer **2** includes an analog circuit block **20** and a digital circuit block **30**. The analog circuit block **20** is provided with circuits of the first to n-th mono input channels, and the first and second EF input channels. Further, in the digital circuit block **30**, a Sys effect processing module **32** having the first effector and the second effector is provided. Moreover, the analog circuit block **20** is provided with an ST bus **20*a*** constituted of L, R for stereo, one AUX bus **20*b***, and two FX buses **20*c*-1**, **20*c*-2** for effect, and the transmission levels of audio signals supplied from the first to n-th mono input channels to the respective buses are controlled individually regarding the respective buses. Audio signals mixed by the ST bus **20*a*** are outputted from a stereo output terminal via an ST output channel **23**, and audio signals mixed by the AUX bus **20*b*** is outputted from the AUX output terminal via an AUX output channel **24**.

Note that when applying an effect, audio signals of any pieces of the first to n-th mono input channels to which it is desired to apply an effect are inputted to either or both of the FX buses **20*c*-1**, **20*c*-2**. The inputted audio signals are mixed by the FX bus **20*c*-1** and/or the FX bus **20*c*-2**, sent to each of the first effector and the second effector of the Sys effect processing module **32** in the digital circuit block **30**, and an effect is applied to the mixed audio signal by each of the effectors. Details of this will be described later.

Structures of the first to n-th mono input channels are all the same, and statuses and parameters of each of the first to n-th mono input channels can be individually set by the switches **13***a*, **13***k*, the knobs **13***b* to **13***i*, and the fader knob **13***m* of the channel strips **10-1** to **10-***n* in the operating panel **1** illustrated in FIG. **1**. For example, structure of the first mono input channel will be described with reference to the operating panel **1** illustrated in FIG. **1**. In a characteristic adjusting module (G/COMP/EQ) **21***a* of the first mono input channel, gain (G) of an audio signal from the input terminal is adjusted. The audio signal is then compressed in a compressor (COMP), and further adjusted in frequency characteristic in an equalizer (EQ). In this case, by operating GAIN **13***b* of the channel strip **10-1**, gain of a head amplifier of the first mono input channel is adjusted to allow sensitivity adjustment, and by operating COMP **13***c*, degree of application of the compressor of the first mono input channel can be adjusted. Turning the COMP **13***c* right allows automatic adjustment of not only the compression effect but also the output level. Further, by operating the HIGH **13***d*, the MID **13***e*, the LOW **13***f*, frequency characteristics of high band, middle band, and low band of a three-band equalizer of the first mono input channel can be adjusted.

By operating the ON SW **13***k* of the channel strip **10-1**, ON/OFF of channel switch **21***b* can be switched. Operating the ON SW **13***k* so as to turn on the channel switch **21***b* allows sending audio signals of the first mono input channel to the ST bus **20***a*, the AUX bus **20***b*, and the FX buses **20***c*-**1**, **20***c*-**2**, and operating the ON SW **13***k* so as to turn off the channel switch **21***b* prevents sending of audio signals of the first mono input channel to the buses. Describing the case where the channel switch **21***b* is turned on, an audio signal outputted from the characteristic adjusting module (G/COMP/EQ) **21***a* is sent in parallel to a fader (F) **21***c* and a volume **21***d* via a channel switch **21***b*, and a lamp incorporated in the ON SW **13***k* turns on, displaying that the channel switch **21***b* is turned on. Here, the volume **21***d* is adjusted by operating the AUX **13***g* of the channel strip **10-1**, enabling to adjust level of the audio signal sent from the first mono input channel to the AUX bus **20***b*. Further, by operating the Fader **13***m* of the channel strip **10-1**, the fader (F) **21***c* is adjusted to enable adjustment of output level of the audio signal of the first mono input channel, thereby enabling adjustment of balance of sound volume between channels. An output from the fader (F) **21***c* is sent to a pan **21***f* and two volumes **21***e*. By operating the PAN **13***j* of the channel strip **10-1**, the pan **21***f* is adjusted, enabling to adjust position of sound image of an audio signal from the first mono input channel in a stereo audio signal of the ST bus **20***a*. Moreover, by operating the EF1 **13***h* and the EF2 **13***i* of the channel strip **10-1**, two volumes **21***e* can be adjusted respectively so as to adjust levels of audio signals, which are adjusted in level by the fader (F) **21***c*, of the first mono input channel being sent to the two FX buses **20***c*-**1**, **20***c*-**2**.

Next, statuses and parameters of the first and second EF input channels can be set by the switches and knobs **14** to **17** of the channel strips **11-1**, **11-2** on the operating panel **1** illustrated in FIG. **1**. The first and second EF input channels have the same structure, and for example, the structure of the first EF input channel will be described with reference to the operating panel **1** illustrated in FIG. **1**. An FX1 output signal is inputted via a channel switch **22***a* to the first EF input channel. The FX1 output signal is a stereo audio signal outputted from the first effector and converted into an analog signal in the digital circuit block **30**. By operating the ON SW **16***b* of the channel strip **11-1**, ON/OFF of the channel switch **22***a* can be switched. Operating the ON SW **16***b* so as to turn on the channel switch **22***a* allows sending of the FX1 output signal from the first EF input channel to the ST bus **20***a* and the AUX bus **20***b*, and operating the ON SW **16***b* so as to turn off the channel switch **22***a* prevents sending of the FX1 output signal from the first EF input channel to the ST bus **20***a* and the AUX bus **20***b*. Explaining the case where the channel switch **22***a* is turned on, the FX1 output signal is supplied to a fader (F) **22***b* and an adder **22***d* via the channel switch **22***a*. The FX1 output signal adjusted in level by the fader (F) **22***b* is sent to the ST bus **20***a*. Further, components L, R of the FX1 output signal are added in the adder **22***d* resulting in a monaural audio signal, which is sent to the AUX bus **20***b* via a volume **22***c*. By operating the Fader **16***c* of the channel strip **11-1**, the fader (F) **22***b* can be adjusted, enabling to adjust level of the FX1 output signal sent from the first EF input channel to the ST bus **20***a*. Further, by operating the AUX **16***a* of the channel strip **11-1**, the volume **22***c* can be adjusted, enabling to adjust the level of the FX1 output signal, which is converted into monaural, sent from the first EF input channel to the AUX bus **20***b*.

Note that to the second EF input channel, an FX2 output signal, which is a stereo audio signal outputted from the second effector and is converted into an analog signal in the digital circuit block **30**, is inputted, and by operating the ON SW **16***b*, the Fader **16***c*, and the AUX **16***a* of the channel strip **11-2**, ON/OFF of the channel switch in the EF input channel **2** can be switched, and each sending level of the FX2 output signal to the ST bus **20***a* and the AUX bus **20***b* can be adjusted.

Audio signals mixed in the two FX buses **20***c*-**1**, **20***c*-**2** are sent to the digital circuit block **30**. Audio signals of two systems, an FX1 input signal from the FX bus **20***c*-**1** and an FX2 input signal from the FX bus **20***c*-**2**, which are inputted to the digital circuit block **30**, are inputted to the ADC **31** and are converted into a digital FX1 input signal and a digital FX2 input signal in the ADC **31**. The digital FX1 input signal is inputted to the first effector of the Sys effect processing module **32**, and the digital FX2 input signal is inputted to the second effector of the Sys effect processing module **32**. In each of the first effector and the second effector, the effect type selected regarding the effector is applied. Note that the first effector and the second effector of the Sys effect processing unit **32** are structured to apply an effect to a stereo audio signal, and hence the effect is applied to a stereo audio signal resulted from dividing a monaural audio signal into L and R. The digital stereo audio signals to which the effects of two systems are applied, that is, the FX1 output signal outputted from the first effector of the Sys effect processing module **32** and the FX2 output signal outputted from the second effector thereof, are converted into analog stereo output signals of FX1 output signal and FX2 output signal in the DAC **33**, which are inputted to the first and second EF input channel, respectively.

Here, FIG. **3** illustrates a circuit block illustrating a detailed structure of the Sys effect processing module **32**.

As illustrated in FIG. **3**, the Sys effect processing module **32** is provided with a first effector **32***a* and a second effector **32***b*. The digital FX1 input signal inputted from the ADC **31** to the first effector **32***a* is divided in two to be a stereo audio signal, and inputted to the first effector **32***a* via adders **32***d*. Further, the digital FX2 input signal inputted from the ADC **31** to the second effector **32***b* is also divided in two to be a stereo audio signal, which is inputted to the second effector **32***b* via adders **32***f*. The FX1 output signal, which is a stereo audio signal to which an effect is applied by the first effector **32***a*, is sent to the DAC **33** and is also sent to the two adders **32***f* via two volumes **32***e*. The adders **32***f* add the FX2 input

signal and the FX1 output signal which is adjusted in level by the volumes **32***e*. Further, the FX2 output signal, which is a stereo audio signal to which an effect is applied by the second effector **32***b*, is sent to the DAC **33** and is also sent to the two adders **32***d* via two volumes **32***c*. The adders **32***d* add the FX1 input signal and the FX2 output signal which is adjusted in level by the volumes **32***c*. The two volumes **32***c* and the two volumes **32***e* can be adjusted by rotating the inter-FX send knob **17** provided across the boundary between the channel strip **11-1** and the channel strip **11-2**. In this case, an analog position signal, which indicates current position of the inter-FX send knob **17**, is supplied from the inter-FX send knob **17** to the digital circuit block **30**. The digital circuit block **30** converts the position signal into digital position data by a not-illustrated ADC and controls the transmission level between the two effectors according to the digital position data as illustrated in FIG. **4**. Further, the first effector **32***a* and the second effector **32***b* are cross-connected with each other, and mode of this cross-connection can be switched by the inter-FX send knob **17**.

FIG. **4** illustrates a diagram illustrating transmission levels (dB) which are amplification factors (attenuation factors) for audio signals adjusted by the two volumes **32***c* and the two volumes **32***e* relative to a rotation operating amount of the inter-FX send knob **17**. In FIG. **4**, the graph with a vertical axis being "1=>2 transmission level" illustrates the transmission level (dB) of the two volumes **32***e* relative to a knob position of the inter-FX send knob **17**, and the graph with a vertical axis being "2=>1 transmission level" illustrates the transmission level (dB) of the two volumes **32***c* relative to the knob position of the inter-FX send knob **17**. Note that "=>" means an arrow.

When the knob position of the inter-FX send knob **17** is at a center position, which is a predetermined position corresponding to a center position, the transmission levels of the two volumes **32***c* and the two volumes **32***e* are zero (level of −∞ (negative infinity)) as illustrated in FIG. **4**. Thus, the FX1 output signal to which an effect is applied by the first effector **32***a* is not inputted to the second effector **32***b*, and the FX2 output signal to which an effect is applied by the second effector **32***b* is not inputted to the first effector **32***a*. In this manner, when the inter-FX send knob **17** is at the center position, the first effector **32***a* and the second effector **32***b* are in a non-connected state, and operate independently in parallel with each other.

Further, when the inter-FX send knob **17** is rotated from the center position to the right side, transmission level of the two volumes **32***e* becomes a transmission level corresponding to the rotation operating amount as illustrated in FIG. **4**, but transmission level of the two volumes **32***c* stays at zero. In this manner, when the knob position of the inter-FX send knob **17** is located on the right side of the center position, the FX1 output signal, to which an effect is applied, outputted from the first effector **32***a* is supplied to the adder **32***f* at a transmission level corresponding to the amount of the rotating operation, but the FX2 output signal, to which an effect is applied, outputted from the second effector **32***b* is not supplied to the adder **32***d*. Thus, only the FX1 input signal is inputted to the first effector **32***a*, and an audio signal of sum of the FX2 input signal and the FX1 output signal controlled in level, which are added by the adders **32***f*, is inputted to the second effector **32***b*, thereby applying the effect to the inputted audio signal. That is, the second effector **32***b* is connected in series after the first effector **32***a*, and this is described on the operating panel **1** as "1=>2". Then, the transmission level of the FX1 output signal to be sent from the first effector **32***a* to the second effector **32***b* at that time can be adjusted by a rotation operating amount toward the right side of the inter-FX send knob **17**.

Moreover, when the inter-FX send knob **17** is rotated from the center position to the left side, transmission level of the two volumes **32***c* becomes a transmission level corresponding to the rotation operating amount as illustrated in FIG. **4**, but transmission level of the two volumes **32***e* stays at zero. In this manner, when the inter-FX send knob **17** is located on the left side of the center position, the FX2 output signal, to which an effect is applied, outputted from the second effector **32***b* is supplied to the adder **32***d* at the transmission level corresponding to the amount of rotating operation, but the FX1 output signal, to which an effect is applied, outputted from the first effector **32***a* is not supplied to the adder **32***f*. Thus, only the FX2 input signal is inputted to the second effector **32***b*, and an audio signal of sum of the FX1 input signal and the FX2 output signal controlled in level, which are added by the adders **32***d*, is inputted to the first effector **32***a*, thereby applying the effect to the inputted audio signal. That is, the first effector **32***a* is connected in series after the second effector **32***b*, and this is described on the operating panel **1** as "2=>1". Then, the transmission level of the FX2 output signal to be sent from the second effector **32***b* to the first effector **32***a* at that time can be adjusted by the rotation operating amount to the left side of the inter-FX send knob **17**.

In this way, the inter-FX send knob **17** has two functions of switching connection between the two effectors and controlling level of an audio signal supplied from one effector to the other effector. Further, since the inter-FX send knob **17** is provided across the boundary between the channel strip **11-1** and the channel strip **11-2**, when the inter-FX send knob **17** is newly provided, it can be provided without enlarging the disposition space on the operating panel **1**. Moreover, since the volumes **32***c* and the volumes **32***e* are such that transmission level of one volume becomes zero or transmission levels of the both volumes are zero (when the inter-FX send knob **17** is at the center position) according to the operating position of the inter-FX send knob **17**, the cross-connection of the first effector **32***a* and the second effector **32***b* does not result in a loop circuit, preventing oscillations and the like.

Next, the audio signal mixed in the ST bus **20***a* is outputted from the stereo output terminal via the ST output channel **23**, and the ST output channel **23** is provided with an ST output channel switch **23***a* and a fader (F) **23***b*. By operating an ON SW **18***c* of the channel strip **12**, the ST output channel switch **23***a* can be turned on/off. Operating the ON SW **18***c* so as to turn on the ST output channel switch **23***a* allows outputting the audio signal from the ST bus **20***a* via the ST output channel **23**, and operating the ON SW **18***c* so as to turn off the ST output channel switch **23***a* prevents sending the audio signal from the ST bus **20***a* via the ST output channel **23**. Then, when the ST output channel switch **23***a* is on, by operating a fader **18***d* of the channel strip **12**, the fader (F) **23***b* can be adjusted, enabling to adjust level of the audio signal from the ST bus **20***a* to be outputted from the stereo output terminal.

Further, the audio signal mixed on the AUX bus **20***b* is outputted from the output terminal via the AUX output channel **24**, and the AUX output channel **24** is provided with a fader (F) **24***a*. By operating the AUX output channel knob **18***b* of the operating panel **1**, the fader (F) **24***a* can be adjusted, enabling to adjust level of the audio signal from the AUX bus **20***b* to be outputted from the AUX output terminal.

FIG. **5** illustrates a diagram illustrating another example of transmission levels of the two volumes **32***c* and the two

volumes **32***e* relative to a rotation operating amount of the inter-FX send knob **17**. On the transmission level illustrated in FIG. **5**, in a predetermined range in which the knob position of the inter-FX send knob **17** is centered at a center position, which is a predetermined position corresponding to a center position, transmission levels of the two volumes **32***c* and the two volumes **32***e* are zero (level of −∞), and the first effector **32***a* and the second effector **32***b* operate independently in parallel with each other. Then, when the inter-FX send knob **17** is rotated beyond the predetermined range on the right side, transmission level of the two volumes **32***e* becomes a transmission level corresponding to the rotation operating amount, but transmission level of the two volumes **32***c* stays at zero. Thus, only the FX1 input signal is inputted to the first effector **32***a*, and an audio signal of sum of the FX2 input signal and the FX1 output signal controlled in level by the volumes **32***e*, which are added by the adders **32***f*, is inputted to the second effector **32***b*. The second effector **32***b* is thus connected in series after the first effector **32***a*. Transmission level of the FX1 output signal to be sent from the first effector **32***a* to the second effector **32***b* can be adjusted by a rotation operating amount toward the right side beyond the predetermined range of the inter-FX send knob **17**.

Further, when the inter-FX send knob **17** is rotated beyond the predetermined range on the left side, transmission level of the two volumes **32***c* becomes a transmission level corresponding to the rotation operating amount, but the transmission level of the two volumes **32***e* stays at zero. Thus, only the FX2 input signal is inputted to the second effector **32***b*, and an audio signal of sum of the FX1 input signal and the FX2 output signal controlled in level by the volumes **32***c*, which are added by the adders **32***d*, is inputted to the first effector **32***a*. The first effector **32***a* is thus connected in series after the second effector **32***b*. Transmission level of the FX2 output signal to be sent from the second effector **32***b* to the first effector **32***a* can be adjusted by a rotation operating amount toward the left side beyond the predetermined range of the inter-FX send knob **17**.

Also regarding the transmission level of this example, the inter-FX send knob **17** has two functions of switching connection between the two effectors and controlling level of an audio signal supplied from one effector to the other effector. Further, since the volumes **32***c* and the volumes **32***e* are such that transmission level of one volume becomes zero or transmission levels of the both volumes are zero (when the inter-FX send knob **17** is in the central predetermined range position) according to operating position of the inter-FX send knob **17**, the cross-connection of the first effector **32***a* and the second effector **32***b* does not result in a loop circuit, preventing oscillations and the like.

FIG. **6** illustrates a diagram illustrating still another example of transmission levels of the two volumes **32***c* and the two volumes **32***e* relative to a rotation operating amount of the inter-FX send knob **17**. On the transmission level illustrated in FIG. **6**, when the inter-FX send knob **17** is at a center position, which is a predetermined position corresponding to a center position, transmission levels of the two volumes **32***c* and the two volumes **32***e* are zero (level of −∞), and the first effector **32***a* and the second effector **32***b* operate independently in parallel with each other. Then, when the inter-FX send knob **17** is rotated toward the right side from the center position, transmission level of the two volumes **32***e* becomes a transmission level corresponding to the rotation operating amount, but transmission level of the two volumes **32***c* stays at zero. Thus, only the FX1 input signal is inputted to the first effector **32***a*, and an audio signal of sum of the FX2 input signal and the FX1 output signal controlled in level by the volumes **32***e*, which are added by the adders **32***f*, is inputted to the second effector **32***b*. The second effector **32***b* is thus connected in series after the first effector **32***a*. Transmission level of the FX1 output signal to be sent from the first effector **32***a* to the second effector **32***b* can be adjusted by a rotation operating amount toward the right side from the center position of the inter-FX send knob **17**, but the initial value thereof is not zero and is a jumped predetermined transmission level.

Further, when the inter-FX send knob **17** is rotated toward the left side from the center position, transmission level of the two volumes **32***c* becomes a transmission level corresponding to the rotation operating amount, but transmission level of the two volumes **32***e* stays at zero. Thus, only the FX2 input signal is inputted to the second effector **32***b*, and an audio signal of sum of the FX1 input signal and the FX2 output signal controlled in level by the volumes **32***c*, which are added by the adders **32***d*, is inputted to the first effector **32***a*. The first effector **32***a* is thus connected in series after the second effector **32***b*. Transmission level of the FX2 output signal to be sent from the second effector **32***b* to the first effector **32***a* can be adjusted by a rotation operating amount toward the left side from the center position of the inter-FX send knob **17**, but the initial value thereof is not zero and is a jumped predetermined transmission level.

Also regarding the transmission level of this example, the inter-FX send knob **17** has two functions of switching connection between the two effectors and controlling level of an audio signal supplied from one effector to the other effector. Further, since the volumes **32***c* and the volumes **32***e* are such that transmission level of one volume becomes zero or transmission levels of the both volumes are zero (when the inter-FX send knob **17** is at the center position) according to the operating position of the inter-FX send knob **17**, the cross-connection of the first effector **32***a* and the second effector **32***b* does not result in a loop circuit, preventing oscillations and the like.

In the above description, although the Sys effect processing module **32** applies an effect to a stereo audio signal, the effect may be applied to a monaural audio signal. Accordingly, a detailed structure of a Sys effect processing module **42** which applies an effect to a monaural audio signal is illustrated in FIG. **7**. This Sys effect processing module **42** may be used in place of the Sys effect processing module **32**.

As illustrated in FIG. **7**, the Sys effect processing module **42** has a first effector **42***a* and a second effector **42***b*. The digital FX1 input signal outputted from the ADC **31** is inputted to the first effector **42***a* as a monaural FX1' input signal via an adder **42***d*. Further, the digital FX2 input signal outputted from the ADC **31** is inputted to the second effector **42***b* as a monaural FX2' input signal via an adder **42***f*. A monaural FX1' output signal to which an effect is applied by the first effector **42***a* is sent to the DAC **33**, and is also sent to an adder **42***f* via a volume **42***e*. The adder **42***f* adds the monaural FX2' input signal and the monaural FX1' output signal controlled in level by the volume **42***e*, and the result is inputted to the second effector **42***b*. Further, a monaural FX2' output signal to which an effect is applied by the second effector **42***b* is sent to the DAC **33**, and is also sent to the adder **42***d* via a volume **42***c*. The adder **42***d* adds the monaural FX1' input signal and the monaural FX2' output signal controlled in level by the volume **42***c*, and the result is inputted to the first effector **42***a*. The volume **42***c* and the volume **42***e* can be adjusted as described above by rotating the inter-FX send knob **17** provided across the boundary between the channel strip **11-1** and the channel strip **11-2**.

Switching of connection between two effectors, the first effector **42***a* and the second effector **42***b*, and controlling level of an audio signal supplied from one effector to the other effector by rotating the inter-FX send knob **17** are similar to the operation in the Sys effect processing module **32** illustrated in FIG. **4** to FIG. **6**, and thus detailed descriptions thereof are omitted.

Further, the monaural FX1' signal and the monaural FX'2 signal are supplied from the DAC **33** to the first and second EF input channels, respectively, and thus it is only necessary to prepare one for monaural as each of the switch **22***a* and the fader **22***b* of each EF input channel, and a monaural signal is supplied from the fader **22***b* to the ST bus **20***a*. Further, an output of the switch **22***a* is a monaural signal, and thus it is not necessary to provide the adder **22***d* which turns a stereo signal into a monaural signal.

INDUSTRIAL APPLICABILITY

The effect applying apparatus of the invention as described above is an effector incorporated in an analog mixer but is not limited thereto, and may be applied to an effector incorporated in other audio apparatuses, such as digital mixers, digital recorders, powered speakers, electronic instruments, and the like for example. Further, it may also be applied to a single effector which is not incorporated in another apparatus.

Further, the embodiment of the effect applying apparatus of the present invention is a digital effector but is not limited thereto, and may be an analog effector. Moreover, in the embodiment, although a first wiring from the output of the first effector to the input of the second effector and a second wiring from the output of the second effector to the input of the first effector exist at the same time, these two wirings only operate exclusively. Accordingly, in the case of a digital effector, it may be controlled so that only a wiring in either one direction according to an operating direction of the knob exists. Specifically, it may be controlled such that when the knob is located on the right side of the center position, the first wiring is performed, and when it is located on the left side of the center position, the second wiring is performed. In this case, when the knob is on the right side of the center position, any input other than the output of the first effector may be cut automatically in the second effector, and when the knob is on the left side of the center position, any input other than the output of the second effector may be cut automatically in the first effector.

Furthermore, the structure of the input channels, buses and output channels is not limited to that of the above described embodiment. For example, although there are only monaural input channels in the above embodiment, a structure which is further provided with stereo input channels may be employed. For example, although there are one ST bus and one ST output channel in the above embodiment, a structure having a plurality of each of them may be employed. Further, although there are one AUX bus and one AUX output channel in the above embodiment, a structure having a plurality of each of them may be employed.

Note that the "predetermined position corresponding to a center position" need not necessary be the midpoint of operable range, and may be a predetermined position displaced to ether one side of the midpoint.

Furthermore, the first effector and the second effector may be realized by an effect applying program activated on a computer. In this case, the effect applying program activated on a computer includes first effector processing and second effector processing, and control similar to the case of the inter-FX send knob **17** according to the above described embodiment of the invention is performed according to the user's operation of one knob displayed on a screen.

Although the above described embodiment of the effect applying apparatus of the invention is an effect applying apparatus incorporated in a mixer, the effect applying apparatus of the invention may be a stand-alone effect applying apparatus having an inter-FX send knob **17** and a circuit block **30**.

Further, although the embodiment (FIG. **3**, FIG. **7**) of the effect applying apparatus of the invention is an apparatus which processes a digital audio signal, it may be an apparatus processing an analogue audio signal.

Moreover, although the inter-FX send knob **17** according to the embodiment of the effect applying apparatus of the invention is a rotating knob which is rotated leftward and rightward and is limited in a rotating range, the inter-FX send knob **17** may be a rotary encoder having no such limit, a slider operated by sliding, a lever operated by moving the lever, or the like.

In the above described embodiment of the effect applying apparatus of the invention, the first effector is constantly supplied with the FX1 input signal and the second effector is constantly supplied with the FX2 input signal, but this is not an essential condition. With the adders (**32***d* and **32***f* of FIG. **3**, and **42***d* and **42***f* of FIG. **7**) on the input side of each effector illustrated in FIG. **3** and FIG. **7** being replaced with selectors, the apparatus may be structured such that when a transmission level from one effector to the other effector is not zero, an FX* input signal (* is 1 or 2) is not supplied to the other effector. More specifically, control may be performed with the above selectors such that (1) when both of "1=>2" transmission level and "2=>1" transmission level are zero, the FX1 input signal is supplied to the first effector and the FX2 input signal is supplied to the second effector, (2) when "1=>2" transmission level is not zero and "2=>1" transmission level is zero, the FX1 input signal is supplied to the first effector and the FX1 output signal adjusted according to the "1=>2" transmission level is supplied to the second effector, and (3) when "1=>2" transmission level is zero and "2=>1" transmission level is not zero, the FX2 output signal adjusted according to the "2=>1" transmission level is supplied to the first effector and the FX2 input signal is supplied to the second effector.

In the above description, since an effect applying apparatus executing an effect applying method of the invention is an effect applying apparatus of the invention, the description of the effect applying method of the invention is omitted.

REFERENCE SIGNS LIST

1 . . . operating panel, **2** . . . mixer, **10-1** to **10-***n* . . . channel strips for mono input channels, **11-1** and **11-2** . . . channel strips for EF input channels, **12** . . . channel strip for ST output channel, **13***a* . . . phantom switch, **13***b* . . . gain adjusting knob, **13***c* . . . compressor adjusting knob, **13***d* . . . high-band adjusting knob, **13***e* . . . mid-band adjusting knob, **13***f* . . . low-band adjusting knob, **13***g* . . . AUX send knob, **13***h* . . . first FX send knob, **13***i* . . . second FX send knob, **13***j* . . . localization position adjusting knob, **13***k* . . . channel switch, **13***m* . . . channel fader, **14** . . . EF number display module, **15***a* and **15***b* . . . SysEF selecting knobs, **15***c* and **15***d* . . . SysEF data adjusting knobs, **16***a* . . . AUX send knob, **16***b* . . . ON switch, **16***c* . . . effect fader, **17** . . . inter-FX send knob, **18***a* . . . AUX return channel knob, **18***b* . . . AUX output channel knob, **18***c* . . . ON switch (ON SW), **18***d* . . . stereo fader (Fader), **20** . . .

analog circuit block, **20***a* . . . ST bus, **20***b* . . . AUX bus, **20***c*-**1** and **20***c*-**2** . . . FX buses, **21***a* . . . characteristic adjusting module, **21***b* and **22***a* . . . channel switches, **21***c* . . . fader, **21***d*, **21***e* and **22***c* . . . volumes, **21***f* . . . pan, **22***d* . . . adder, **23** . . . ST output channel, **23***a* . . . ST output channel switch, **23***b* and **24***a* . . . faders, **24** . . . AUX output channel, **30** . . . digital circuit block, **31** . . . ADC, **32** and **42** . . . Sys effect processing modules, **32***a* and **42***a* . . . first effectors, **32***b* and **42***b* . . . second effectors, **32***c*, **32***e* and **42***e* . . . volumes, **32***d*, **32***f*, **42***d* and **45***f* . . . adders, **33** . . . DAC

The invention claimed is:

1. An effect applying apparatus comprising:

first effector circuitry for applying a first audio effect to an audio signal supplied to the first effector circuitry;

second effector circuitry for applying a second audio effect to an audio signal supplied to the second effector circuitry;

a user-operable control for being operated, by a displacing operation by a user, for transitioning between different operating positions; and

controller circuitry for:

switching, based on the user-operable control transitioning between different operating positions, between two different orders of operative connection between the first effector circuitry and the second effector circuitry, and

controlling a level of an audio signal supplied from one of the first effector circuitry and the second effector circuitry disposed in a previous stage to the other of the first effector circuitry and the second effector circuitry disposed in a subsequent stage, according to an amount of displacement of an operating position of the user-operable control from a predetermined position of the user-operable control.

2. An effect applying apparatus comprising:

first effector circuitry for applying a first audio effect to an audio signal InF1 supplied to the first effector circuitry;

second effector circuitry for applying a second audio effect to an audio signal InF2 supplied to the second effector circuitry;

a knob to be operated by user operation; and

controller circuitry for controlling supply of the audio signals InF1 and InF2 to the first effector circuitry and the second effector circuitry,

wherein, when the knob is displaced toward a first direction from a predetermined position corresponding to a center, said controlling by the controller circuitry comprises:

controlling a level of an audio signal OutF1 outputted from the first effector circuitry according to an amount of the displacement of the knob and

supplying the audio signal OutF1 after its level id controlled, as the audio signal InF**2**, to the second effector circuitry to make the second effector circuitry output an audio signal OutF1F2 to which the first audio effect is applied and then the second audio effect is applied, and

wherein, when the knob is displaced toward a second direction from the predetermined position, said controlling by the controller circuitry comprises:

controlling a level of an audio signal OutF2 outputted from the second effector circuitry according to amount of the displacement of the knob and

supplying the audio signal OutF2 after its level is controlled, as the audio signal InF**1**, to the first effector circuitry to make the first effector circuitry output an audio signal OutF2F1 to which the second audio effect is applied and then the first audio effect is applied.

3. The effect applying apparatus according to claim **2**, comprising:

wherein, when the knob is displaced toward said first direction from the predetermined position, said controlling by the controller circuitry comprises:

supplying a sum of the audio signal OutF1 after its level is controlled and an audio signal InAdd**2**, as the audio signal InF2, to the second effector circuitry, and

wherein, when the knob is displaced toward said second direction from the predetermined position, said controlling by the controller circuitry comprises:

supplying a sum of the audio signal OutF2 after its level is controlled and an audio signal InAdd**1**, as the audio signal InF1, to the first effector circuitry.

4. The effect applying apparatus according to claim **2**,

wherein, when the knob is placed at the predetermined position corresponding to the center, said controlling by the controller circuitry comprises:

supplying the audio signal InF1 to the first effector circuitry to make the first effector circuitry output an audio signal OutF1notF2 to which the first audio effect is applied, the audio signal OutF1notF2 not supplied to the second effector circuitry, and

supplying the audio signal InF2 to the second effector circuitry to make the second effector circuitry output an audio signal OutF2notF1 to which the second audio effect is applied, the audio signal OutF2notF1 not supplied to the first effector circuitry.

5. A method for applying audio effect comprising:

applying a first audio effect with first effector circuitry to an audio signal InF1 supplied to the first effector circuitry;

applying a second audio effect with second effector circuitry to an audio signal InF2 supplied to the second effector circuitry; and

controlling supply of the audio signals InF1 and InF2 to the first effector circuitry and the second effector circuitry according to position of a knob which is to be operated by user operation,

wherein, when the knob is displaced toward a first direction from a predetermined position corresponding to a center, said controlling comprises:

controlling a level of an audio signal OutF1 outputted from the first effector circuitry according to amount of the displacement of the knob and

supplying the audio signal OutF1 after its level is controlled, as the audio signal InF**2**, to the second effector circuitry to make the second effector circuitry output an audio signal OutF1F2 to which the first audio effect is applied and then the second audio effect is applied, and

wherein, when the knob is displaced toward a second direction from the predetermined position, said controlling comprises:

controlling a level of an audio signal OutF2 outputted from the second effector circuitry according to amount of the displacement of the knob and

supplying the audio signal OutF2 after its level is controlled, as the audio signal InF**1**, to the first effector circuitry to make the first effector circuitry output an audio signal OutF2F1 to which the second audio effect is applied and then the first audio effect is applied.

6. The method for applying audio effect according to claim 5,

wherein, when the knob is displaced toward said first direction from the predetermined position, said controlling comprises:

supplying a sum of the audio signal OutF1 after its level is controlled and an audio signal InAdd2, as the audio signal InF2, to the second effector circuitry, and

wherein, when the knob is displaced toward said second direction from the predetermined position, said controlling comprises:

supplying a sum of the audio signal OutF2 after its level is controlled and an audio signal, as the audio signal InAdd1, InF1, to the first effector circuitry.

7. The method for applying audio effect according to claim 5,

wherein, when the knob is placed at the predetermined position corresponding to the center, said controlling comprises:

supplying the audio signal InF1 to the first effector circuitry to make the first effector circuitry output an audio signal OutF1notF2 to which the first audio effect is applied, the audio signal OutF1notF2 not supplied to the second effector circuitry and

supplying the audio signal InF2 to the second effector circuitry to make the second effector circuitry output an audio signal OutF2notF1 to which the second audio effect is applied, the audio signal OutF2notF1 not supplied to the first effector circuitry.

8. The effect applying apparatus according to claim 1, wherein the user-operable control is a knob.

9. The effect applying apparatus according to claim 8, wherein the user-operable control is a rotating knob, and the displacement is a rotation of the rotating knob from the predetermined position.

10. The effect applying apparatus according to claim 1, wherein the displacement is signaled to the controller circuitry by an analog position signal.

11. An effect applying apparatus comprising:

a computer including a display,

the computer, via an effect applying program activated on the computer, configured for performing:

first effector processing for applying a first audio effect to an audio signal supplied to the first effector processing;

second effector processing for applying a second audio effect to an audio signal supplied to the second effector processing;

displaying on the display a user-operable control for being operated, by a displacing operation by a user, for transitioning between different operating positions;

switching, based on the user-operable control transitioning between different operating positions, between two different orders of operative connection between the first effector processing and the second effector processing; and

controlling a level of an audio signal supplied from one of the first effector processing and the second effector processing disposed in a previous stage to the other of the first effector processing and the second effector processing disposed in a subsequent stage, according to an amount of displacement of an operating position of the user-operable control from a predetermined position of the user-operable control.

12. The effect applying apparatus according to claim 11, wherein the user-operable control is a knob displayed on the display.

13. The effect applying apparatus according to claim 12, wherein the user-operable control is a rotating knob, and the displacement is a rotation of the rotating knob from the predetermined position.

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